

MICRO-INVASIVE TREATMENT OF THE NON-CAVITATED CARIOUS LESIONS IN THE SMOOTH SURFACES OF TEETH

Luiza Ungureanu¹, Albertine Leon², Anca Nicolae³, Ciobanu Gabriela⁴

1. Prof. PhD, Dept of Odontology, „Ovidius” University of Constanța, Faculty of Dental Medicine
 2. Assist. Prof., Dept of Odontology, „Ovidius” University of Constanța, Faculty of Dental Medicine
 3. Assist. Prof., Dept of Odontology, „Ovidius” University of Constanța, Faculty of Dental Medicine
 4. Assist. Prof., Dept of Endodontics, „Ovidius” University of Constanța, Faculty of Dental Medicine
- Corresponding author – Luiza Ungureanu, e-mail: luizastom@yahoo.com

Abstract

Aim: Experimentation of a new, micro-invasive treatment technique, addressed to the incipient, non-cavitated carious lesions.

Materials and method: Icon is an innovative product for the micro-invasive treatment of the carious non-cavitated lesions occurring on smooth surfaces, requiring – after a preliminary conditioning of lesion's surface with 15% hydrochloric acid – infiltration of the porous layer obtained with a low-viscosity composite.

Results: 26 non-cavitated carious lesions (22 vestibular and 4 proximal lesions, respectively) were selected and treated by this technique in the Department of Odontotherapy, between October 2010-July 2011. According to the protocol of the Icon technique, a smooth and glossy surface was obtained through infiltrating the lesion, similarly to the healthy enamel, the aesthetic aspect being re-established.

Conclusions: The Icon technique may be successfully applied as a method of micro-invasive treatment of the non-cavitated carious lesions produced on smooth surfaces. The studies performed evidenced the efficacy and acceptability of this clinical procedure.

Keywords: non-cavitated carious lesions, smooth dental surfaces, infiltration, Icon

INTRODUCTION

The chalky-white spot, as the first visible evidence of a caries in the enamel, involves demineralization of the enamel under a superficial pseudo-intact layer.

Non-cavitated *vestibular caries* are frequently occurring in the cervical third of the teeth, causing aesthetic problems mainly in the frontal zone and difficult restoration. They are caused by acid erosions, by the bacterial plaque, as well as by the fixed orthodontic devices, in patients with poor dental hygiene. Even if the lesions may be stopped by prophylactic remineralizing measures, the deep ones, responsible for demineralization of enamel and of the external third of the dentin,

are remineralized, in most cases, only superficially; the body of the lesion, situated beneath, is still porous, which explains the persistency of the whitish and/or brownish aspect, caused by the penetration of certain pigments, foodstuff colouring substances, tobacco, chromogenic bacteria. Therapeutical solutions, such as: direct veneers of composite materials, ceramic veneers, direct composite restorations, are all invasive techniques, involving removal of dental tissue.

For the *non-cavitated enamel caries occurring on the proximal surfaces*, the possible prevention, remineralization and treatment solutions are even more difficult to apply.

For all such clinical situations, the **ICON technique [1] is the most efficient micro-invasive alternative, leading to satisfactory aesthetic results.** The procedure assumes *infiltration of the non-cavitated carious lesions of the smooth surfaces* after a preliminary conditioning of the lesion surface with 15% hydrochloric acid, which increases enamel porosity. This way, the lesions of the enamel loose their whitish, chalky aspect, becoming optically quite similar to the healthy enamel, as a result of microporosities' filling with a fluid composite material, which prevents any advance of the lesion and offers a pleasant aesthetic aspect.

The aim of this investigation is to implement this recent, innovating technique as a solution for clinical cases.

MATERIALS AND METHOD

Between October 2010-July 2011, the Icon technique was applied in the Odontotherapy Clinic of the Faculty of Dental Medicine of

Constanța, to 26 non-cavitated lesions of enamel smooth surfaces.

The product is available in two variants: **Icon Proximal** – for the treatment of *incipient proximal caries* and **Icon Smooth Surface** – *for smooth, vestibular and oral surfaces*.

The Icon technique is efficient in cases of demineralization of the enamel layer and of the outer third of the dentin (E1, E2, D1), but not for deeper lesions in dentin (D2, D3), Fig. 1.



- E1 – lesion present in the outer half of dentin;
- E2 – lesion present in the inner half of dentin;
- D1 – lesion present in the outer third of dentin;
- D2 – lesion present in the middle third of dentin;
- D3 – lesion present in the inner third of dentin.

Fig. 1. Radiographic lesion depth classification of dental caries according to bite-wing x-rays [1]

Such a procedure of enamel infiltration cannot be applied to enamel defects caused by fluorosis, hypoplasia, traumas; it is not applied directly on either dentin or cement.

Each kit of Icon treatment (proximal, respectively, vestibular) contains: a 0.3 ml screw syringe with demineralizing gel (Icon Etch – 15% hydrochloric acid); a 0.45 ml screw syringe with

dessicant (Icon Dry – 95-100% ethanol); a 0.45 ml screw syringe with infiltrant (yellow liquid acrylic resin); 6 proximal (respectively, smooth surface) tips; 4 interdental wedges (for the Icon Proximal kit) (Figs. 2-4). [1]

The clinical protocol includes the following steps [1]:

1. For the treatment with Icon proximal:

- professional teeth brushing; washing with water and air drying; checking the interdental spaces with dental floss; application of the rubber dam; slow separation with the interdental wedge provided in the treatment kit;
- application of hydrochloric acid on the surface of the lesion for 2 minutes; the perforated part of the proximal tip contacts the lesion; the acid gel is released through rotation of the screw;
- washing the acid for 30 seconds; air drying the tooth;
- application of the Icon-dry dessicant on the lesion for 30 seconds; air drying;
- application of the infiltrant upon the lesion for 3 minutes, which enters the porous enamel through the perforated part of the proximal tip; the lamp of the dental unit will be turned off (not to initiate polymerization); removal of the excess material with dental floss; photopolymerization, for 40 seconds, from all directions; repeated application of the infiltrant for one minute and photopolymerization;
- removal of the dental wedge, of the rubber dam and finishing with abrasive strips.



Fig. 2. Icon treatment kits



Fig. 3. Proximal tip (for acid gel and infiltrant resin)



Fig. 4. Smooth surface tip (for acid gel and infiltrant resin)

2. For the treatment with **Icon smooth surface**:

- professional teeth brushing; washing with water and air drying; checking the interdental spaces with dental floss; application of the rubber dam or of the liquid dam;
- application of hydrochloric acid on the surface of the lesion for 2 minutes;
- washing the acid for 30 seconds; tooth drying;
- application of the Icon-dry dessicant on the lesion for 30 seconds; air drying; the chalky aspect of the lesion will be more pronounced; if need be, demineralization is resumed for 2 minutes;
- application of the infiltrant on the lesion for 3 minutes; the lamp of the dental unit will be turned off; removal of the infiltrant excess with prefabricated (denser) cotton rolls; photopolymerization for 40 seconds; repeated application of the infiltrant for one minute and photopolymerization;
- removal of the rubber dam and finishing.

RESULTS

Between October 2010 – July 2011, the Icon technique was applied according to its specific criteria, in the Odontotherapy Clinic of the Faculty of Dental Medicine of Constanța, to 26 non-cavitated carious lesions (4 proximal and 22 vestibular lesions of white-spot type), among which special mention should be made of the following:

Clinical case 1: Patient C.A., 23 year-old – 1.1 incipient enamel lesion, type E1 (Figs. 5-10).

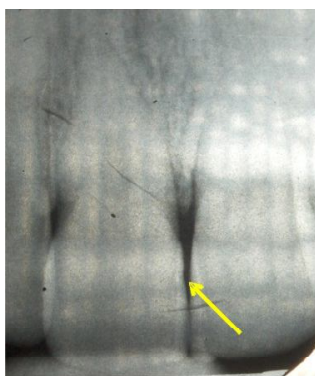


Fig. 5. 1.1 Incipient enamel lesion



Fig. 6. Creating the operatory field

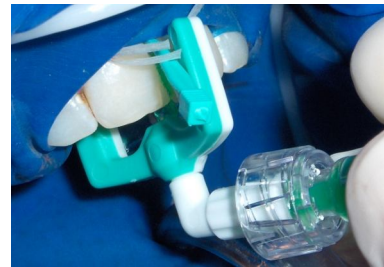


Fig. 7. Application of acid gel (Icon Etch – 15% hydrochloric acid, 2 min.)



Fig. 8. Application of Icon Dry dessicant (95-100% ethanol, 30 sec.)



Fig. 9. Application of infiltrant resin (liquid acrylic resin, two times)



Fig. 10. Final aspect of carious lesion on 1.1, treated by the Icon technique

Clinical case 2: Patient S.N., 28 year-old, having non-cavitated, chalky-white erosive lesions, as well as cavitated lesions in the third neck segment of the frontal upper teeth. The non-cavitated lesions were treated by the Icon technique (1.3, 1.1 and 2.2), and the cavitated ones, by direct composite restorations (1.2 and 2.1) (Figs. 11-16).



Fig. 11. Initial aspect of lesions



Fig. 12. Application of retraction cord to better expose the lesions



Fig. 13. Application of liquid dam and Icon Etch



Fig. 14. Application of Icon Dry



Fig. 15. Application of infiltrant resin with brushing motions



Fig. 16. Final clinical aspect

Clinical case 3: Patient P.B., 23 year-old, with white-spot type erosion lesions on teeth 1.2, 1.3 and 1.4, treated by the Icon technique (Figs. 17-20).



Fig. 17. Erosive dental lesions on teeth 1.2, 1.3, 1.4



Fig. 18. Isolation with liquid dam. Aspect of teeth surfaces after applying Icon Etch and Icon Dry



Fig. 19. Brushing the infiltrant resin onto the lesion surface to penetrate the porous area



Fig. 20. Final aspect of the infiltrated lesions, after light polymerization

DISCUSSION

The concept of caries infiltration was developed at Charité University of Berlin, by Prof. Dr. A.M. Kielbassa, and continued at the University of Kiel, by Prof. Dr. Christof Dörfer. As a result of the close cooperation with these two universities, Dr. H. Meyer-Lückel, Dr. Sebastian Paris and DMG manufacturing enterprise put into practice the results of the research, as product Icon (September 2009) [1].

Caries infiltration is a topic of particular interest nowadays, which explains the numerous studies – some of them still in progress – devoted to it. In this respect, Rocha Gomes Torres *et al.* [2] observed that product Icon proved to be the most efficient treatment in masking the chalky aspect of the white-spot type lesions, comparatively with a 0.05% fluoridated solution, while the teeth treated with Icon were more resistant to the formation of new chalky-white lesions. Lohbauer *et al.* [3] concluded that the infiltrated vestibular lesions were less affected by brushing abrasion than the normal enamel. Saviero *et al.* [4] evidenced that only one-minute application of the infiltration resins at the level of the proximal 6-year molars permitted penetration of the infiltrant to sufficient depth inside the lesions. Meyer-Lückel and Paris [5] compared two acrylic resins with different penetrability coefficients, which may enter the body of the lesion through capillarity, if the lesion is dessicated with ethanol. Their conclusion was that the resin with a higher penetrability coefficient is capable of infiltrating the enamel almost completely, when using ethanol as a dessiccant. Nobrega

et al. [6] determined the resistance of the lesions treated with Icon on extracted human, artificially demineralized teeth, on the VHN (Micro-Vickers hardness test) scale, as compared to fluoridation and the invasive treatment. They demonstrated that the artificially created carious lesions, treated with Icon, registered favourable results in the resistance test. Martignon *et al.* [7] evaluated radiologically the efficiency of the infiltration with resins of the incipient proximal carious lesions, as against the sealing and the use of dental floss, along one to two-year periods of time. The conclusion was that infiltration of the incipient proximal caries constitutes an efficient method to reduce the progress of carious lesions. Kim S *et al.* [8], who evaluated the clinical efficacy in masking the chalky-white lesions with resin, by the Icon infiltration technique, derived a good aesthetic aspect for teeth with post-orthodontic demineralization. Phark and Duarte [9] compared the infiltration efficacy *versus* post-orthodontic fluoridation of the chalky-white lesions, reaching the conclusion that resin infiltration reduces efficiently the post-orthodontically occurring chalky-white lesions, while ensuring good colour stability in time. By means of confocal laser scanning microscopy, Paris S, Meyer-Lückel H, Müller J *et al.* [10] were able to appreciate the depth of resin penetration, as well as the absence of caries advancement after infiltration.

Restoration, through the Icon technique, of a limited number of clinical cases, allowed the subsequent observations: a careful selection of the clinical cases with porous demineralization lesions is necessary, to allow infiltration of the liquid resin as deeply as possible inside the lesions; clinical examination through careful inspection of the vestibular surfaces, and through bite-wing radiographs for the proximal dental surfaces, is equally necessary to settle correct diagnosis; for the vestibular surfaces, the technique is very simple and rapid, while, for the proximal ones, the manoeuvre is more complex – however, gradually, the time necessary to accomplish it may be reduced; even if, under certain clinical situations, the aesthetic result was less obvious, sensitivity in the tooth neck zone of the treated teeth disappeared.

CONCLUSIONS

- The Icon technique may be applied in practice as a simple, efficient, micro-invasive method in treating non-cavitated lesions in the smooth surfaces of teeth, securing both infiltration inside the lesion and stopping demineralization, while restoring the aesthetic aspect, a compulsory requirement mainly in case of lesions occurring on the vestibular surfaces of teeth.
- Despite its recent application (2009), numerous studies have already ascertained the efficiency of this technique, recommending its extended application; nevertheless, further clinical and paraclinical studies – performed on an as large number of treatments as possible – as well as their monitorization in time, are still necessary.
- Clinical experience evidenced that the patients accepted a conservative method, causing practically no pain, yet providing immediate satisfaction.

References

1. www.drilling-no-thanks.com
2. Rocha Gomes Torres C, Marcondes Sarmento Torres L, Silva Gomes I, Simoes de Oliveira R, Buhler Borges A. *Effect of caries infiltration technique and fluoride therapy on the color masking of white spot lesions*, www.dmg-dental.com/downloads/scientific-documents
3. Lohbauer U, Ebert J, Schubert EW, Petschelt A. *In-vitro-Resistenz von kunststoff-infiltrierter Initialkaries (White Spots) gegenüber Zahnburstabrasion*. 2009, www.dmg-dental.com/downloads/scientific-documents
4. Saviero V, Paris S, Séllos M, Meyer-Lückel H. *Effects of application time on infiltrant caries penetration ex vivo*. J Dent Res 2010; 89 (Spec Iss A): 2521.
5. Meyer-Lückel H, Paris S. *Infiltration of natural lesions with experimental resins differing in penetration coefficients and ethanol addition*. Caries Res 2010; 44: 408-414.
6. Nobrega D, Perry R, Kaminsky E, Finkelman M, Kugel G. *Unique treatment of early caries and white spot lesions*. J Dent Res 2010; 89 (Spec Iss A): 2522.
7. Martignon S, Ekstrand KR, Lara JS, Gomez J, Cortes A. *2-Year Radiographic Results of Proximal Caries Lesions' Infiltration, Sealing and Flossing Instructions*, www.dmg-dental.com/downloads/scientific-documents
8. Kim S, Shin JH, Kim EY, Lee SY, Yoo SG. *The evaluation of resin infiltration for masking labial enamel white spot lesions*. Caries Res 2010; 44: 171-248, Abs. 47.
9. Phark JH, Duarte S. *Clinical performance and color stability of infiltrated smooth surface lesions*. www.dmg-dental.com/downloads/scientific-documents
10. Paris S, Meyer-Lückel H, Müller J, et al. *Progression of sealed initial bovine enamel lesions under demineralizing conditions in vitro*. Caries Res. 2006; 40(2):124-129.